Paper 4: Review of the Paper *'What Is Time And What Causes Time?'* prepared by Dr. Mohammad H. Khan, Chicago, USA

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Executive summary

Several issues have been identified within Dr. Khan's paper, including his statements that gravity is not a force, that time is caused by the expansion of space, that an object of mass must be moving in order to curve spacetime, and that inertia is related to the curvature of spacetime.

The two most significant issues identified are considered to be his statement that the movement of matter can only result from a time gradient, and his belief that gravity is not a force. A time gradient may be the only means by which 'Time' can cause the movement of matter, but it is not the only means by which matter can be moved. Matter can also be moved through the interaction with other matter, or through its interaction with light. My paper also demonstrates why (in my opinion) gravity is a force, and not simply an action.

1. Introduction

I found Dr, Khan's paper very useful because it helped to clarify some of the issues I have with my own theories about time and gravity. I am not a physicist, I am a retired civil engineer, but I believe engineers and physicist share some professional attributes.

A good engineer always believes they are right, but at the same time recognises that he or she could be wrong. A good engineer actively looks for things that can go wrong with their design, and does not just focus on why things should work. Similarly a good physicist should actively look for potential problems with their theories, and should not just focus on why they must be correct.

By reviewing Dr. Khan work I am actively looking for potential problems with my own theories, while also expanding my knowledge thanks to Dr. Khan's hard work. I would like to thank Dr. Khan for the opportunity to review his work, and to gain from his knowledge.

I cannot confirm that Dr. Khan's opinions are either true or false. I can only present my concerns, and my justification for these concerns, and then ask the readers to judge for themselves. Dr. Khan's opinions are more likely to be consistent with the opinions of current experts, it is just that I do not find these opinions to be logical.

To help in this discussion I have tried to use the term 'Time' (with a capital) when referring to the science of Time, and the term 'time' (without a capital) when referring to the passage of time.

Before I begin with my comments on Dr Khan's paper I would like to note that Time (i.e universal Time) is different from what humans measure as time (i.e. a clock). Consider, for example, the human concept of 'light'. We see light as something that brings brightness to an area of darkness, something we can see, something that can have colour. However, all these sensations exist only in our brain. As far as science and the universe are concerned, light is just electromagnetic radiation that has no brightness, visual qualities, or colour. There is no 'light' or 'dark' side of the moon, just one side that receives and reflects electromagnetic radiation from the sun at any given time.

Similarly, how humans see time with regards to clocks and calenders is not the same as how the universe uses Time in connection with matter, space, energy and light.

2. Comments on the work of Dr Mahammad H. Khan of Chicago IL

Dr. Khan wrote: *'Slowing of time without sliding into the past or the future suggests that time is a process and not a dimension.'*

I accept that Time is a process, but it is also a 'dimension'. The following discussion (like many of the discussions within this paper) is for the reader's benefit, not for Dr. Khan's benefit.

The best way to think about the passage of time is to consider how we accept the different time zones that humans have adopted around the world. We know that at 2:30 pm on a Sunday in May the Kentucky Derby horse race is run in the USA. We also know that when it is 2:30 pm on a Sunday in Kentucky, it will be 4:30 am on a Monday morning in Brisbane, Australia; however, nobody in Kentucky is ringing Australia prior to the horse race in order to find out which horse won the race. The race occurs at the same Earth time everywhere in the universe (not just everywhere on Earth). It occurs at 2:30 pm Sunday Kentucky time, and 4:30 am Monday Brisbane time, both of which can be considered as Earth time.

Time is one of the dimensions we use to define a given location and point in time. For example the Kentucky Derby will start at 2:30 pm Kentucky time, at Earth grid coordinates of 38°12' North, and 274°14' East.

In the above example the 'rate of time' is the same for both Kentucky and Brisbane, which is different from the recorded 'time'. If you have trouble understanding how variations in the 'rate of time' could exist at the same 'time' within the universe, then try to think of these variations in time as simply variations in the rate that things occur, such as the rate of motion, or the rate of aging.

If the rate of time suddenly slowed on a motor racing track, but not in the adjacent spectator grandstand, then to a spectator in the grandstand (i.e. an outside observer) the cars would suddenly appear to be moving slower. If a timing clock was mounted within the race track time zone, then the spectators would see that the race clock was also moving slower. On the other hand, for the racing drivers on the track (i.e. inside observers) their cars would appear to be travelling at the same speed as they were before the time change, and the speedometer within their cars would confirm this fact. So the issue is not so much about the 'passage of time' as it is about the appearance of motion as witnessed by either an observer inside the time zone, or one outside the time zone.

We know that when we place a tub of butter in the frig, the rate of 'aging' of the butter slows, but this does not mean that things inside a frig go back in time. Similarly, when a twin travels to a zone of space that has a slower rate of time, all that really happens is a slowing of the twin's aging process. The travelling twins aging in Earth years remains the same as for the twin that remained on Earth, but the travelling twins aging in Space years is less than it is in Earth years.

Dr. Khan wrote: *'Time is the presence of motion and forces and it is caused by the expansion of space.'*

How does 'Time' know how big space is? The only things that know how big space is are the first rays of light that left the Big Bang 13.77 billion years ago. The only way Time could know how big space is would be for Time to be travelling at light speed, or for space and Time to exist before the Big Bang. Also, how does Time at the edge of space, tell Time in the middle of space, that space is getting bigger?

The only way for space to exist **prior** to the arrival of light would be for space to have existed prior to the Big Bang (which is what some experts believe), but this would mean that space had already achieved its maximum size, and therefore would no longer be increasing in size.

However, if Time is formed from energy during the Big Bang, then the energy of time would likely be spreading out across space, which would suggest that Time, and the rate of time, are both slowing with time (i.e. as space increases).

I believe there is evidence that suggests that Time has the ability to hold and release energy, and that time energy may in fact be the dark energy that scientists have been looking for. If this is correct, then it would seem logical that Time is expanding, and that the expansion of Time is the cause of the expansion of visible matter (i.e. galaxies). However, I see no logic in the statement than Time 'is caused by the expansion of space'.

Dr. Khan wrote: *'When an object is pushed it interacts with expanding space. Expansion slows in front of the object slowing time and increases behind the object making time faster. The object moves in time differential from faster to slower time. This happens at the level of the atoms and is the cause of inertia.'*

I am not sure about this statement. When you push an object it accelerates (if we ignore friction), which from Dr. Khan's statement means that the time differential is increasing as a result of the force, but Dr. Khan also suggests (in the next paragraph) that a force only introduces mass to an object, and that the increase in velocity is a result of a decrease in potential energy.

Dr. Khan wrote: *'. . . when a mass is accelerated by application of a force it can only become more massive . . . This happens as the energy of the force goes into increasing the mass and not into increasing the velocity. The increase in kinetic energy due to velocity is accompanied by decrease in potential energy just as in a falling mass . . .'*

It is noted that a mass can be accelerated without changing its velocity, such as when a mass is forced to change its direction.

When a spaceship uses side thrusters to change its direction (i.e. accelerate), but not its speed, then this, in theory, would not add mass to the spaceship. However, if the thrusters were placed at the rear of a spaceship and used to increase the spaceship's velocity, then this would add mass to the spaceship. But how does the same force produce two different outcomes? How does the force know to add mass in one case, but not in another?

Consider another example. Let us imagine that a baseball pitcher threw a baseball at 100 kph towards a batter. The batter then hits the ball with a force that sends the ball back over the pitcher's head at the same 100 kph speed. The combined potential energy and kinetic energy of the baseball remains unchanged, even though a significant force has been applied to the ball. Now using the theory presented in Dr Khan's paper, it would be the pitcher that added mass to the baseball when it was first accelerated, but the force applied by the batter did not add mass.

Now consider a batter tossing a baseball in the air, then hitting it so that it achieved the same speed of 100 kph. In this case the force applied by the batter would, in theory, add mass to the baseball. But, in this case the force applied by the batter is approximately half the first case where no mass was added to the system. But how does the force know what to do in each case?

I understand that physics has determined that an object of mass will achieve infinite mass if it were accelerated up to the speed of light, but I cannot see the logic in concluding from this statement that *'the energy of the force* [only] *goes into increasing the mass and not into increasing the velocity'.*

With regards to the statement that: '*The increase in kinetic energy due to velocity is accompanied by decrease in potential energy just as in a falling mass . . .'* I would like to add the following:

- The potential energy used in the acceleration of a falling mass comes from the potential energy stored within the mechanics of gravity, not stored within the falling object.
- When a spaceship is outside the influence of gravity, its only source of potential energy is its fuel and its own mass. So if a spaceship was able to increase its velocity to near the speed of light it would need to turn all of its mass (i.e. its potential energy) into kinetic energy, but the accepted theory is that an object's mass would increase to an infinite value if the speed of the object approaches the speed of light. So these two outcomes appear to be in conflict.
- When you lift an object of mass from ground level to a greater height, you are storing potential energy within gravity (lets say spacetime). When you let that object fall to the ground, the potential energy stored in this additional stretching of spacetime is used as the force of gravity to accelerate the object, and thus introduce kinetic energy into the object.

Dr. Khan wrote: *'For a mass falling in time differential of gravity where there is no accelerating force (just weightlessness) the gain in kinetic energy* [equation inserted] *is accompanied by decrease in potential energy and there is no increase in mass.'*

With regards to the statement that a person in free fall is weightless, and that gravity is not a force, I would respectfully disagree. I will also add that I am concerned about how many experts state that while a person is floating during an 'anti-gravity' flight, they are weightless. I agree the person is experiencing the feeling of weightlessness, but they are not weightless at any stage during the flight.

Any time a 'mass' exists within a gravitational field, it has weight, even in free fall (unless it is neutrally buoyant). As humans we don't feel the force of gravity on our body because of how our brain works. It is just a mental trick.

The best way to explain this mental trick is to think about the force of weight that passes through our body (Figure 1). Our head has weight, which places a force on our shoulders, similarly our upper body has weight, which places a force on our legs, and our whole body has weight which exerts a force on the ground. However while we are standing, we don't feel the weight of our head on our neck, we don't feel the weight of our upper body on our legs, but we do feel the weight of our whole body being transferred through our feet onto the ground—why?

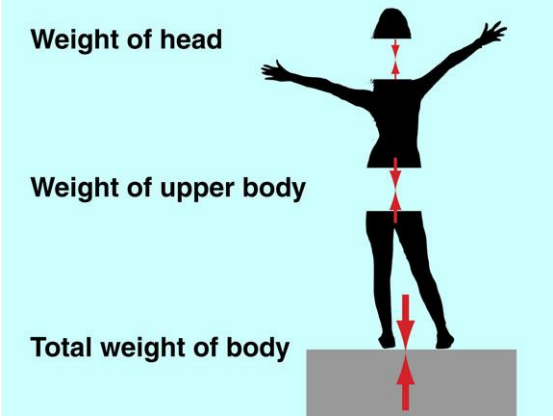

Figure 1 – Forces carried through the body

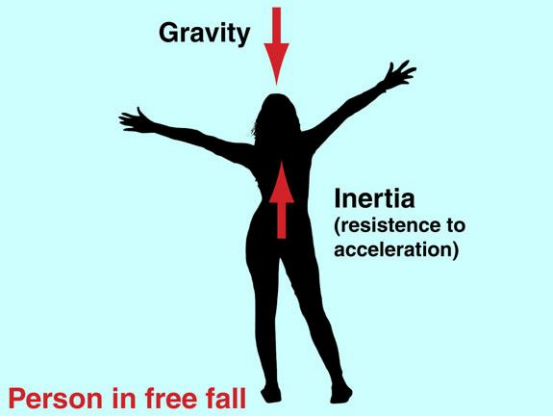

Figure 2 – Forces on a person in free fall

There are two reasons why this is the case. Firstly, gravity is not a force that acts on the outer surface of a body, it is a force that acts on each individual unit of mass (atom) within our body. Secondly, the human brain trains itself to ignore the feeling of gravity on our upper body.

Gravity does not know what a person is, or a rock, or a baseball. If any of these objects move through a gravity field, then gravity sees only units of mass. The force of gravity acts on each individual unit of mass within the human body. Gravity is not a force that acts on the outer surface of a body. In effect, gravity is an external force that acts internally. We cannot feel this force because it does not act like a normal external force, such as the force we feel on our back when a car accelerates.

With regards to the second issue, our brain turns off the messages of weight that it receives from our neck and torso, but not from our feet. This is because the weight messages from our neck and torso provide no ongoing benefit to our day-to-day activities, but the weight messages received from our feet remain important to the brain because these messages are used to help us to stand, run and walk.

It is a bit like wearing a watch; eventually your brain turns off the feeling of wearing a watch because it just becomes background 'noise' as far as the brain is concerned (Figure 3).

Think about that fact that if you place a motor bike helmet on our head you can feel the weight of the helmet on your neck, even though the helmet weighs less than your own head.

If you are lucky enough to be a royal subject you may feel the weight of a heavy crown on your neck, but not the weight of your own head. It is just how the brain works.

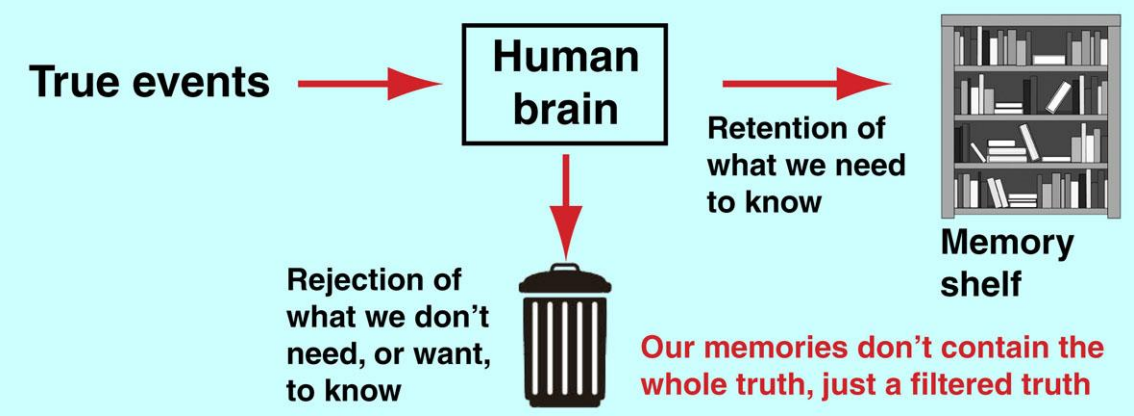

Figure 3 – Mental processing of information

So, when we are in free fall (Figure 2) we do not feel any of the effects of the force of gravity on our body because our brain has turned off these messages. It is NOT because we are weightless, it is just that we feel weightless.

We can feel the force of gravity when we are standing on the surface of the Earth, and we call this force 'weight'. Now imagine that you are standing on a diving board high above a pool. You can feel your weight through your feet. And the force of your weight is balanced by the force of the diving board pushing up on your feet.

If you step off the driving board, the gravitational force that was acting on your body has not gone away. This force continues to act on your body causing you to accelerate towards the pool. Now this gravitational force needs to be balanced by an equal and opposite (in direction) force, which is supplied by your body's inertia, i.e. its resistance to the acceleration (Figure 2). The fact that you don't feel these forces does not mean they are not there.

Our body has 'mass', and as we fall that mass is being accelerated at 9.8 m/s/s, which means a force is involved, and this force is gravity. We know that gravity produces a force because we feel it in our feet when we stand. We can also feel the force of gravity when we hold an object stationary above the ground. This is a force that exists even when the object is held still (relative to the Earth).

Now lets look at the physics experiment of a leaky jar, filled with water, that is held in the air (Figure 4). When the jar is held still, water spills from the holes in the base of the jar as would be expected. If the jar is released, water stops spilling from the jar. Does this mean the water is now weightless and no longer feeling the force of gravity – well No!

Let us repeat the experiment, but this time we will separate the water and the jar, and we will use a touch of magic to hold the unconfined water still in the air (Figure 5). If we let both the water and jar go at the same time, then both the water and the jar would accelerate at the same rate of 9.8 m/s/s, meaning the water stays level with the jar, and the mass of water would retain its shape if it were falling through a vacuum. The same thing happens in the first case. Water stops spilling out of the jar not because it is weightless, but because if it were to continue to spill from the jar it would need to be accelerating faster than 9.8 m/s/s.

If you are still not convinced, then think about two magnets being attracted to each other, but being temporarily held apart. While they are being held apart you can feel the force of the magnetic attraction. If you let one magnet go, it will accelerate towards the other magnet. The magnetic force has not disappeared just because you have let go of one of the magnets. Similarly, the force of gravity does not disappear simply because you step off a diving board.

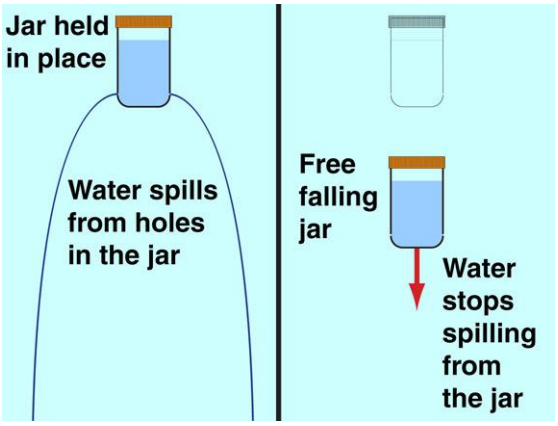

Figure 4 – The falling water jar experiment

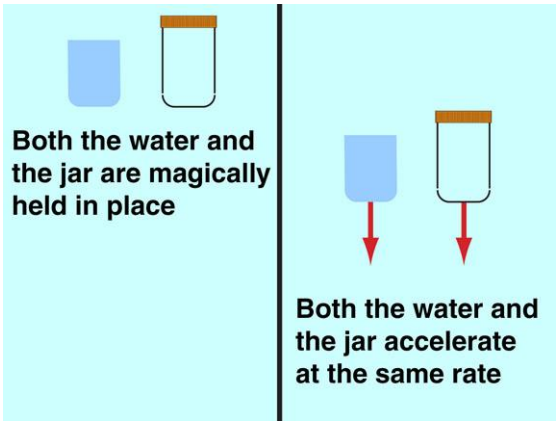

Figure 5 – Alternative presentation of the falling water jar experiment

Dr. Khan wrote: *'The amount of motion and forces in the form of potential and kinetic energy (that is imparted to a mass by the expanding space) is a constant. Therefore when objects are falling in a gravitational field and no force is felt there is no increase in mass with increase in velocity. The potential energy is being converted into kinetic energy of fall.'*

The problems with this statement are outlined in the following questions:

- Where does the potential energy come from? — Remember, 'height' is not a form of energy.
- How is this potential energy transferred into a falling object if it is not transferred by a force?

When an object is allowed to fall within a gravitational field, it doesn't call up its local 'potential energy distributor' and ask for a burst of energy. When you lift an object of mass you store potential energy by stretching the spacetime that surrounds the Earth just that little bit further out into space.

If you then allow the object to fall, the stretching of spacetime is allowed to slightly relax, and the force of gravity is exerted on the object causing it to accelerate.

The potential energy cannot be stored within the object as added mass because this would mean that every object that is lifted into outer space is taking a bit of additional mass-energy away from the Earth. If all the Earth's mass were removed and taken into outer space, then Dr. Khan's theory would mean that the net mass of the Earth would increase.

Dr. Khan wrote: *'It is easy enough to see that time is slow where expansion of space is expected to be slow as around large masses suggesting that time is caused by the expansion of space.'*

I see no logic in this statement. If the logic is easy enough to see, then I am afraid that I just don't see it.

Dr. Khan wrote: *'Gain in Kinetic energy during free fall is exactly balanced by reduction in potential energy due to slowing of time in gravity. There is no force felt by the accelerating mass and no gain in mass.'*

Again, I disagree with this statement. We know that gravity produces a force. We feel it in our legs when we stand. That force does not disappear just because we are in free fall.

Dr. Khan wrote: *'Objects are made of billions of particles moving at high orbital velocities (time dependent potential energy). When these masses are placed in a time differential the atomic motion is being converted into the kinetic energy of fall making the mass move from faster to slower time producing the effect of gravity.'*

Here is my problem with this statement. If an electron in an atom is said to have 30 Joules of kinetic energy due to its velocity (just a fictitious number), then if the atom moves into a region of slower time, its kinetic energy will remain at 30 Joules. Also, if a spaceship moves into a slower time zone, its velocity remains unchanged. Only to an outside observer in a faster time zone will the spaceship appear to be travelling slower.

As Dr. Khan wrote earlier: *'. . . speed of light is constant only when measured in a local reference frame in local space and by local time.'* This means you cannot judge the speed of an electron or atom from a location outside the local time zone. It also means that within a slower time zone, light will appear to be travelling at the same speed, a person's heart will continue to beat at the same rate as before, and an electron will be travelling at the same velocity with the same kinetic energy as it would in a faster time zone.

Nothing inside a time zone changes when the rate of time changes. The only thing that changes is what we view outside that time zone. Both an atomic clock and a mechanical spring-loaded clock will continue to operate exactly the same way no matter which time zone they are in. Only to an outside observer will the clocks appear to be behaving differently.

This means that when a mass is placed in a time differential, its atomic motion cannot be converted into kinetic energy because the degree of atomic motion remains unchanged.

Dr. Khan wrote: *'Gravity is always attractive as it can only operate between faster and slower time that is mediated by differences in expansion of space making it one of the strangest forces.'*

It is my opinion that there are no 'attracting' (attractive) forces in the universe. The only forces that exist are 'repelling' forces. Any force that appears to be an attracting force is simply a repelling force that is yet to be fully understood. One day, even electromagnetism will be understood only in terms of repelling forces.

In order for a force to act on an object it must surround the object, push up against the object, or drag along the side of the object, i.e. there must be an effective physical contact. There are no invisible 'ropes' within the universe that a force can use to 'pull' on an object. For example, you cannot be 'sucked' into a drainage pipe, you can only be pushed or dragged.

The Earth does not pull you towards the ground, the spacetime that surrounds the Earth pushes you towards the ground. Stars and planets don't pull themselves into a spherical shape, they are pushed into a spherical shape, similar to bubbles in a glass of champagne.

Dr. Khan wrote: *'As mentioned earlier in a free fall there is no gain in mass with increase in velocity as no force is acting on the mass and no acceleration is felt by the falling object. This important point appears to be missing from textbooks of physics and is ignored by physicists.'*

I believe this statement is missing from textbooks because I believe it is wrong!

Dr. Khan wrote: *'. . . when increase in velocity is produced by acceleration with application of a force (Rocket ship) there is gain in mass. The accelerating force causes the mass to constantly feel the acceleration. The energy of the force applied is being converted into mass.'*

I refer the readers to my previous discussion with regards to a spaceship's side thruster supposedly not adding mass to the spaceship, while a rear thruster apparently will add mass!

I can also point out that if Object X (being pushed with Force F causing Acceleration A) is compared to Object Y which is also being pushed with Force F, but has reached its terminal velocity (i.e. the input force equals the total drag), then we would have a case where Object X would supposedly be gaining mass, but Object Y would not gain mass, but how does the force know what to do in each case?

Dr. Khan wrote: *'During deceleration the mass can absorb back the kinetic energy* [equation insert] *as potential energy as now the slowing of time is no longer present and the mass again has higher allowed potential energy capacity. This process is same as conversion of kinetic to potential energy in a pendulum as it rises to a higher point and enters a zone of space with higher allowable potential energy.'*

I respectfully suggest that when a pendulum rises to a higher point it stores potential energy by stretching spacetime just that little bit further as it moves further away from the surface of the Earth. The potential energy is stored in the stretching of spacetime, not within the pendulum.

Dr. Khan wrote: *'The moving object interacts with space slowing the expansion of space in front of the object, slowing time (eq#2.) The space behind the object interacts with the object to expand faster causing faster time (eq#4), this creates a time differential which then perpetuates motion.'*

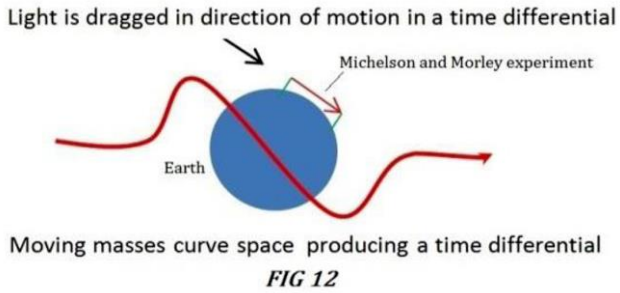

Figure 6 – Figure 12 in Dr Khan's paper

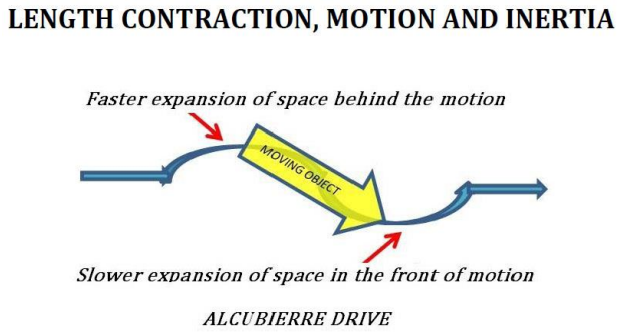

Figure 7 – Another figure in Dr Khan's paper

It is my understanding that:

- the Earth's orbit of the Sun results in the Earth travelling at around 30 km/s
- our solar system orbits the centre of the Milky Way at a speed of around 200–220 km/s
- the Milky Way is travelling through space at a speed of around 368 km/s.

Consequently it is estimated that the Earth is moving through space at a speed of around 600 km/s. If the mechanics presented within the above two diagrams were correct, then the Earth would experience a **significant** variation in the rate of time from one side of the Earth to the other. In fact, based on the above explanation, I am concerned that some people would be ejected from the Earth due to reverse gravity.

To the best of my knowledge, the Earth's gravitational field is near uniform in all directions around the Earth, which would suggest:

- the above discussion is wrong; and
- the gravitational field around the Earth is not governed by the Earth's direction of travel through space.

Dr. Khan wrote: *'. . . we just know that moving objects have slower time.'*

This statement does not explain why the force of gravity varies with the inverse of the square of the distance from the centre of a mass, even though, in theory, the space around the Earth is not moving.

The diagram (Figure 8) appears to be a gross over-complication of the time differential discussion; however, I do understand that this diagram is a representation of other people's work.

THE MINKOWSKI DIAGRAM COMPARED WITH MODIFIED SPACE TIME DIAGRAM

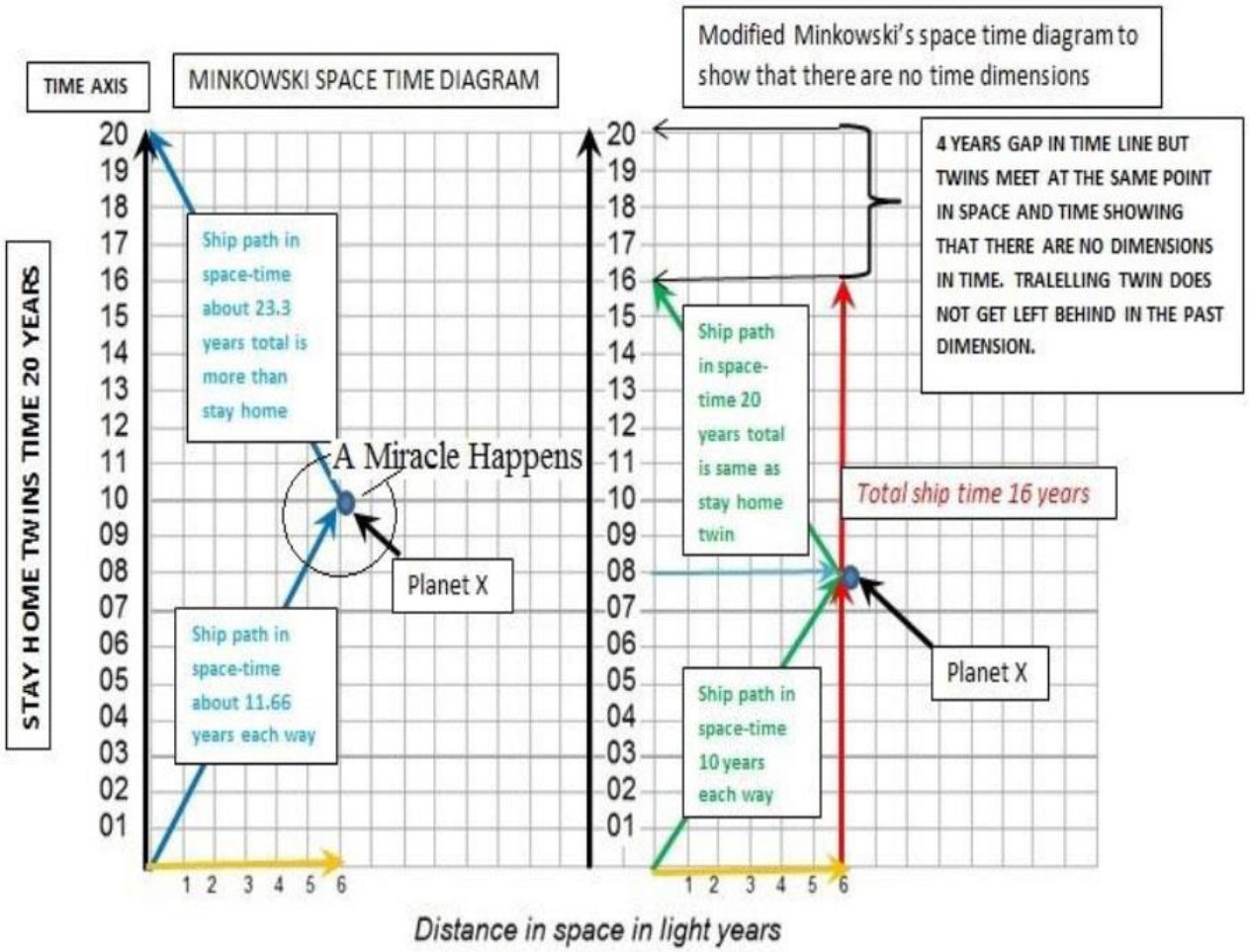

Figure 8 – Dr Khan's diagram title 'The Minkowski Diagram Compared with Modified Space Time Diagram'

When a person enters a region of slower time, the only thing that changes is the speed of all motion associated with that person, but only with respect to an outside observer located in a region of faster time. As far as the space traveller is concerned, nothing changes. For the traveller, clocks will appear to behave normally, the spaceship will be travelling at the same speed (as far as the on-board instruments show), and the traveller's body will be aging at the normal rate.

However, to an outside observer, such as a twin waiting back on Earth, it would appear that the space-travelling twin is moving slower through space, as well as aging slower.

If the space-travelling twin travels on a journey that takes 20 Earth years, then that space-travelling twin will be 20 Earth years older when he or she returns to Earth. The only thing that will happen to the space-travelling twin is that their body cells would have aged slower, and their satellite phone would have processed time at a slower rate. Consequently the space-travelling twin will believe that they have only been travelling for 16 Space years.

When I read discussion about the Twin Paradox I feel that the whole argument is a giant waste of the minds of brilliant people. A resolution of the paradox lies in an understanding of the conditions that allow a slowing in the rate of time.

If the slowing of time is directly related to the velocity of an object in space, then the two twins would be travelling at different velocities, so there is no paradox. The issue is not how each of the twins view each other's velocity, but how their velocity varies relative to space. The 'reference point' in space MUST be the same as that originally used to determine that the rate of time slows when travellers move at high velocity. You cannot compare two events unless you have a standard

frame of reference, and that frame of reference must be the same as that used to develop the original theory.

Dr. Khan wrote: *'Objects are composed of trillions of atoms with kinetic energy of electrons moving in tremendous orbital velocities. Imagine placing this mass in a time differential (which is gravity) and the internal kinetic motion of the electrons is converted to external linear motion. This is how I believe gravitational acceleration is produced.'*

When an atom is placed in a time differential it is effectively placed in a location with a reduced rate of time. The mechanics associated with electrons rotating around a nucleus would remain unchanged. As far as the atom is concerned, the velocity of its electrons would remain unchanged.

Even though the slower rate of time would cause an actual slowing of the electrons as viewed by an outside observer, this 'apparent' slowing of speed occurs in association with a similar slowing of time, so the actual speed of the electron (as observed by an inside observer) would remain unchanged. This means that the forces that hold the electrons in rotation around the nucleus would remain in balance, thus no changes would occur within the atom.

If the 'rate of time' were constantly reducing across the universe, then nothing would change for anyone living on Earth. The only thing that would change is our measurements of those events we witness outside our time zone.

Grant Witheridge
June, 2022